

The haploid chromosome number, 9, is based on examination of microsporocytes of three plants from the type locality and two plants from Rancheria Road (*Vasek 125*). Permanent slides and herbarium vouchers are on file in the herbarium of the University of California, Los Angeles.

Relationship. *Clarkia exilis* is morphologically very similar to *C. unguiculata* and is undoubtedly most closely related to this species. The hybrid between them is difficult to produce in the garden, however, and the two species remain distinct in the field although they frequently occur in mixed colonies throughout the known range of *C. exilis*. Where the two species grow together our field observations indicate that they are easily distinguished on the basis of habit as well as the long spreading pubescence on the ovary and calyx of *C. unguiculata*. However, variants of *C. unguiculata* without conspicuous hairs on the ovary and calyx are found in other areas. No single character distinguishes all of the variants of *C. unguiculata* from *C. exilis*, but in general the relative length of the ovary and calyx at anthesis is definitive. The length of the ovary in *C. exilis* is about equal to the length of the sepals and hypanthium combined; the ovary of *C. unguiculata*, on the other hand, is conspicuously shorter than the combined length of the sepals and hypanthium.

A study, by Vasek, of the morphological and cytogenetical relationship of these two species is still in progress.

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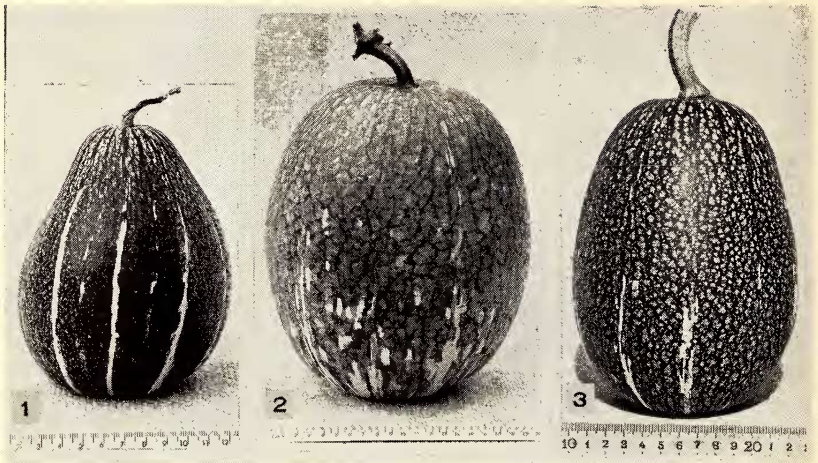
A CROSS BETWEEN AN ANNUAL SPECIES AND A PERENNIAL SPECIES OF CUCURBITA

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Except for *Cucurbita ficifolia* Bouché, a perennial, the species of cultivated *Cucurbita* are annuals (*C. pepo* L., *C. maxima* Duch., *C. mixta* Pang., and *C. moschata* Duch.). Repeated attempts to hybridize *C. ficifolia* with the four annual species have been failures, although occasionally small parthenocarpic fruits are set when pollen of *C. ficifolia* is used on female flowers of *C. pepo*. These results have been interpreted to mean that the sterility barriers between *C. ficifolia* and the four annual species are normally sufficient to prevent a flow of genes in either direction.

The perennial habit is of considerable interest in this group, appearing to be an adaptation to xerophytic conditions, and it becomes increasingly significant in relation to the northward spread of members of the group from tropical and subtropical Central America and southern Mexico to the deserts of northern Mexico and southwestern United States. In

¹ Aided by a grant from The American Academy of Arts and Sciences. My thanks are due to G. A. Sanderson, Agricultural Aid, for preparation of the illustrations.



FIGS. 1-3. Mature fruits. FIG. 1. *Cucurbita andreana*. FIG. 2. *Cucurbita ficifolia*. FIG. 3. F₁ (*C. andreana* × *C. ficifolia*).

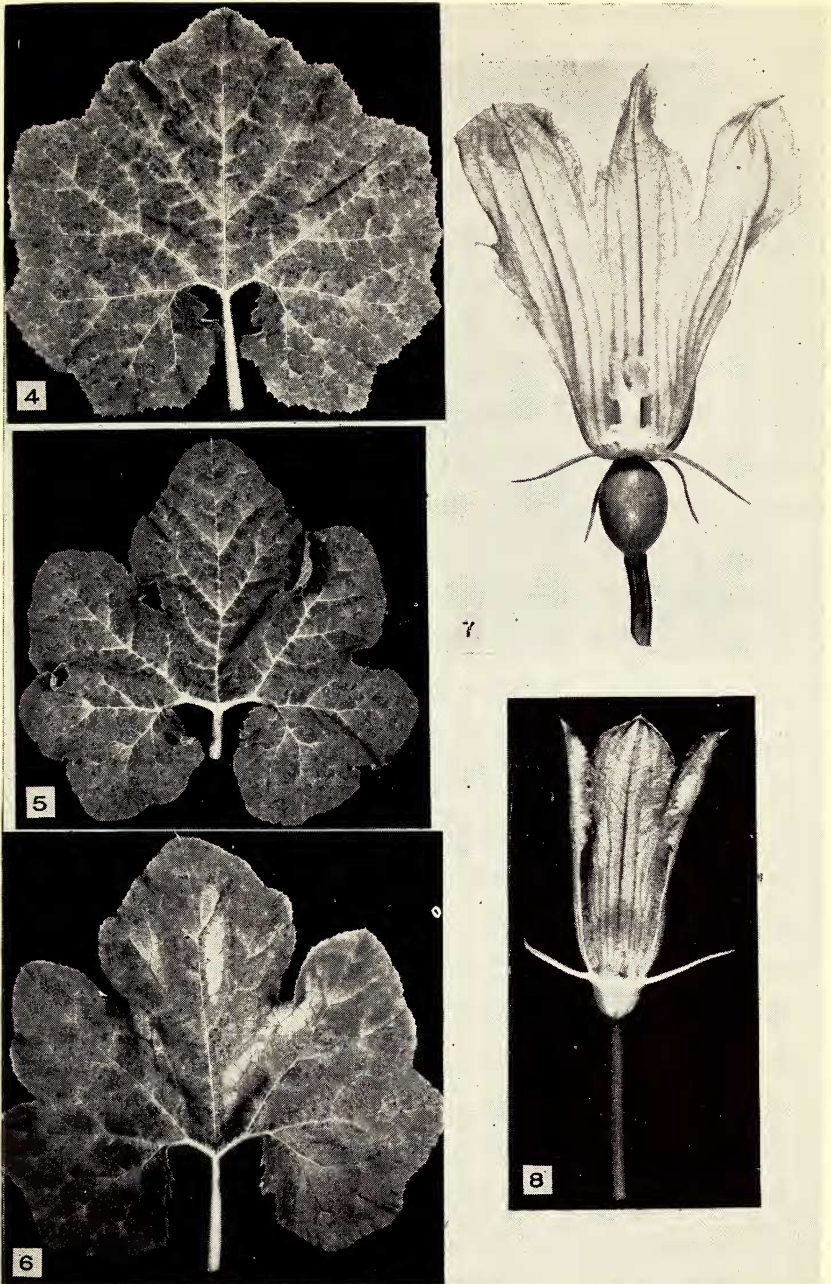
Cucurbita it is important to learn something about the genetics of the perennial habit, as it may help in understanding the intricate relationships between the cultivated and the wild species.

In a further attempt to shed light upon the relationship of *Cucurbita ficifolia* to the cultivated annual species, *C. ficifolia* was mated with *C. andreana* Naud., an annual which is evidently the wild prototype of *C. maxima* (Whitaker, 1951). When pollen of *C. ficifolia* was placed on pistillate flowers of *C. andreana*, three fruits were obtained from a dozen pollinations. The results of genetic and cytological observations on the behavior of these hybrid plants are recorded herein. In earlier attempts to make this cross, fruits were obtained, but the seeds were flat and mostly empty or contained small aborted embryos.

METHODS AND RESULTS

Cucurbita andreana and *C. ficifolia* were described in previous publications (Whitaker, 1951; Whitaker and Bohn, 1950). The fruit of *C. andreana* is an oval, medium-sized, hard-shelled, bitter-fleshed gourd with mottled dark green skin (fig. 1). The vine habit is running rather than bush; typically, every runner produces roots at the node. Fruits of *C. ficifolia* are large and usually have a mottled light green skin (fig. 2). The flesh is white and stringy but not unpleasant to the taste. The variety used in these experiments had large, black seeds with light margins. The plants produce strong, vigorous runners, which may or may not root at each node.

Of the three fruits obtained from twelve pollinations of *C. andreana* × *C. ficifolia*, one was normal in appearance, and the others were small and under-developed. Each fruit contained numerous seeds, the majority of



FIGS. 4-6. Mature leaves. FIG. 4. *Cucurbita andreana*, $\times 2/5$. FIG. 5. *Cucurbita ficifolia*, $\times 1/2$. FIG. 6. F_1 (*C. andreana* \times *C. ficifolia*), $\times 1/3$. FIGS. 7, 8. Flowers of F_1 (*C. andreana* \times *C. ficifolia*). FIG. 7. Pistillate flower, $\times 1/2$. FIG. 8. Staminate flower, $\times 1/2$. Note short staminal column and lack of pollen.

them flat. When the seeds were dissected, the embryos were found to be small and poorly developed or completely absent.

When planted, seeds from the smallest fruit failed to emerge. From the other two fruits about one dozen plants emerged, of which six were albino lethals, and did not produce true leaves before they died. Several of the green plants had cotyledons with white sectors. However, the first true leaves were normal green, and thereafter the plants were extremely vigorous. F₁ plants were transplanted and observed in the field during two successive years. Their behavior was similar each year.

As noted above the F₁ plants when transplanted to the field were extremely vigorous, with runners up to fifty-five feet in length. The runners root at each node, resembling *C. andreana* in this respect. In cross-section, they are 5-angled, but not sharply so as in *C. ficifolia*. In contrast *C. andreana* has runners that are round in cross-section. The hybrid appeared to be an annual under our conditions.

The leaves of the hybrid (fig. 6) are intermediate in appearance between those of the parents (figs. 4 and 5). The setae of the leaves, petioles and stems are more or less soft and flexible, much like those of *C. ficifolia*; those of *C. andreana* are harsh and stiff to the touch.

Staminate flowers usually abort prior to anthesis, but an occasional flower may open in normal fashion (fig. 8). Pistillate flowers were produced at irregular intervals, but not in great abundance (fig. 7). Fruits set readily when the flowers are open pollinated or backcrossed to either parent. However, all fruits from these matings and the open pollinated fruits were parthenocarpic. More than fifty fruits have been examined. The seeds were small, flat and under-developed. When dissected there was no evidence of an embryo within the seedcoats. Apparently almost any kind of pollen furnishes sufficient stimulation to cause fruit development, but apparently no fertilization takes place. The mature fruits were intermediate in size between those of the two parents (fig. 3), but they had a hard shell and bitter flesh similar to those of *C. andreana*. The peduncle was sharply 5-angled and slightly flared at the fruit attachment. Except for size, the exterior appearance of the fruit is much like that of *C. ficifolia*.

Since the staminate flowers of the F₁ plants almost always deteriorate prior to anthesis, pollen counts of opened flowers were not obtained. However, pollen grains from unopened flowers were studied. In aceto-carminic smears of more than ten flowers, no stainable pollen grains were observed.

In comparable smears of anthers from both parents, 97 per cent stainable pollen was recorded for each.

The cytological picture in the F₁ hybrid was one of great irregularity. Of the twenty chromosomes contributed by each parent, not more than ten were paired. The unpaired chromosomes migrate precociously to the poles, thus producing metaphase plates with many irregularities. Some of the unpaired chromosomes are lost in the cytoplasm, and at M II, plates

with eighteen to twenty-two pairs of chromosomes were frequently observed. The irregularities at meiosis probably account for complete sterility of pistillate and staminate flowers.

CONCLUSIONS

It may be concluded from the observations recorded above that:

1. *Cucurbita ficifolia* is genetically well separated from the cultivated annual species. Its closest connection is probably with *C. maxima* through *C. andreana*, the wild prototype of this species. However, the sterility of the F_1 hybrid between *C. andreana* \times *C. ficifolia* is so complete that an exchange of genes is stopped in the initial stages.

2. The F_1 hybrids were extremely vigorous after the first true leaves appeared. Usually only pistillate flowers reached anthesis in the F_1 plants. They were sterile when backcrossed to either parent. Parthenocarpic fruits were produced in great abundance by the F_1 plants. The great vigor of the F_1 plants can be accounted for in part by the fact that the vines produce no seed, but this explanation may be only partial. It is likely that hybrid vigor may have made a considerable contribution to the unusual growth of these plants.

3. For the most part the characters contributed by *Cucurbita ficifolia* were dominant in the hybrid, e.g., fruit shape, skin color; angled stem and petiole; more or less soft, pliable setae. The following *C. andreana* characters were evident: hard shell, bitter flesh, and annual growth habit.

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A NEW SPECIES OF BOWLESIA FROM PAKISTAN

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The genus *Bowlesia* consists of three rather well-defined groups of species which have been accorded different status by different authors. The first group consists of those Chilean plants with erect, dichotomously branched stems and with stipules reduced to discrete cilia. These Bentham (1867) referred to his section *Homalocarpus* while Drude (1897) to his section *Elatae*. The second and third groups comprise weak-stemmed, prostrate, or spreading plants with evident, usually lacerate or fimbriate stipules; the second group has fruits bearing essentially sessile stellate hairs but no glochidia, whereas the third group has separate glochidia or, more commonly, a glochidiate wing extending along the